Gulf of Mexico Hypoxia Monitoring and Modeling

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Oxygen-depleted or hypoxic bottom waters covering a large region of the northern Gulf of Mexico over the last few decades is well documented. The primary cause of Gulf hypoxia, which exceeded 20,000 km^2 during the summers of 2001 and 2002, has been identified as an increase in nutrient loading from the Mississippi-Ohio-Missouri River Basin. A national strategy to reduce the frequency, duration, size, and degree of hypoxia in the northern Gulf (Hypoxia Action Plan, 2001) established three long-term goals: (1) by 2015, reduce the 5-year running average areal extent of the Gulf hypoxia zone to less than 5,000 km^2, (2) restore and protect the waters of the Mississippi/Atchafalaya River Basin (MARB) through nutrient and sediment reduction actions, and (3) improve communities and economic conditions across the MARB through improved land management and a cooperative incentive-based approach.

The USEPA Office of Research and Development, in partnership with the Gulf of Mexico Program Office, the Office of Water, and Regions 4 and 6, have implemented efforts that will help guide the science needed to address the Gulf hypoxia problem. The goal is to develop a risk-based modeling framework that will aid water resource managers in making scientifically defensible nutrient restoration decisions to reduce the areal extent of Gulf hypoxia and restore the natural habitats along the coast. The framework integrates monitoring, condition assessment, diagnosis, and experimentation within a multimedia, mathematical modeling construct to establish forecasting capabilities. The approach is to implement a field monitoring program to collect the data required to calibrate and validate a high-resolution 3-D model coupling atmospheric, hydrodynamic, surface wave, sediment resuspension, transport and diagenenis, and water quality/eutrophication submodels.

The monitoring program includes seasonal field surveys and was initiated in December 2002 aboard USEPA's Ocean Survey Vessel *Peter W. Anderson*. Using a statistically based survey design, these surveys are collecting new data to (1) characterize the magnitude and variability in physical, chemical, and biological state variables and processes across large temporal (seasonal) and spatial (shelf-wide) scales and (2) define the seaward boundary conditions. Increasing the scale and frequency of field surveys will better define the spatial and temporal extent and dynamics of the hypoxic zone and linkages to MARB nutrient loads. The synthetic modeling framework is needed to establish a nutrient-loading threshold with known certainty to promote recovery and restoration of dissolved oxygen, evaluate the success of nutrient reduction efforts, and meet the goals of the National Hypoxia Action Plan.